Operational Test Command (OTC) Analytic Simulation and Instrumentation Suite (OASIS) Brings Live Players to the Modeling Architecture for Technology, Research, and EXperimentation (MATREX) and Other Benefits of MATREX-OASIS Teaming

Paper is most relevant to: Live, Virtual, and Constructive (LVC) capabilities

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In February 2007, the Program Manager for Modeling Architecture for Technology and Research EXperimentation, (MATREX), a Research, Development and Engineering Command (RDECOM) effort contacted the US Army Operational Test Command (USAOTC) to determine and explore potential partnering and teaming opportunities. Specifically, whether or not there was a way to incorporate a *richer live integration* into the MATREX federation. Finally, guided by the requirements of their customers, USAOTC decided in 2005 to pursue linking these systems together through the MATREX Federation Object Model (FOM) and run-time infrastructure (RTI) to create a true system of systems (SoS) test capability under a program called OASIS Integration. Both organizations were also linked through the Cross Command Collaboration Effort (3CE), which seeks to leverage and enable cross-command connectivity, collaborative requirements determination, common hardware, software solutions, and collaboration tools that are derived from common analytic requirements for test, evaluation, and analysis.

The MATREX and USAOTC Modeling and Simulation (M&S) technologists met to discuss each programs' capabilities, requirements, and plans. Several areas were identified as holding potential benefit to both organizations. One area identified was data exchange requirements to bring live players into the MATREX federation and to interact with RDECOM models, through the use of the Operational Test Tactical Engagement System (OT-TES) and its Common Data Link (CDL). Another area identified was OTC leveraging the MATREX tools to move to an HLA environment. This included using ProtoCore, which enables future compliance with such standards as RTI1516 and Test and Training Enabling Architecture (TENA) without the cost of rebuilding their source code. An additional area of collaboration was for OTC to use the MATREX System Design Description (SDD), which provides a rich expression of the MATREX architecture, and to leverage many models already existing and integrated within the MATREX environment.

This paper identifies these and other benefits of this cooperative effort. While OTC and RDECOM obviously benefit by this partnering and teaming, other commands and programs will realize benefits to their efforts as well.

Operational Test Command (OTC) Analytic Simulation and Instrumentation Suite (OASIS) Brings Live Players to the Modeling Architecture for Technology, Research, and EXperimentation (MATREX)

1. Introduction

In February 2007, the Program Manager for Modeling Architecture for Technology and Research EXperimentation, (MATREX), a Research, Development and Engineering Command (RDECOM) effort contacted the US Army Operational Test Command (USAOTC) to determine and explore potential partnering and teaming. Specifically, whether or not there was a way to incorporate a *richer live integration* into the MATREX federation. The MATREX and USAOTC Modeling and Simulation (M&S) technologists met to discuss each programs' capabilities, requirements, and plans. Several areas were identified as holding potential benefit to both organizations. One area identified was data exchange requirements to bring live players into the MATREX federation and to interact with RDECOM models, through the use of the Operational Test Tactical Engagement System (OT-TES) and its Common Data Link (CDL). Another area identified was OTC leveraging the MATREX tools to move to an HLA environment. This included using ProtoCore, which enables future compliance with such standards as RTI1516 and Test and Training Enabling Architecture (TENA) without the cost of rebuilding their source code. As a direct result of these technical interchange meetings both organizations agreed to an initial series of joint collaborative JOSIE/MATREX integration events hosted at Fort Hood, TX.

2. OTC and OASIS

The USAOTC is meeting its near-term mission requirements for integration through a series of Integration Events (IEs) utilizing a High Level Architecture (HLA) approach in the form of the MATREX Federation Object Model (FOM) and Run Time Interface (RTI). These events, occurring regularly over the past year, have systematically increased in level of complexity and scope, culminating in a seamless integration of live and constructive simulation entities made possible, in part, by a robust MATREX FOM and RTI. This paper provides an overview of the past years integration events.

The United States Army Test and Evaluation Command (ATEC) performs the test and evaluation mission for the US Army. ATEC Operational Testing (OT), by definition, requires a representative soldier / unit conducting their mission on the actual equipment (not prototypes) within a realistic representative operational environment. The data collected is provided to the ATEC evaluators who prepare reports required by Army decision makers. Historically, the realistic high-definition and high granularity environment was created/built by ATEC OTC using state-of-the-art technologies (e.g. modeling, simulation, instrumentation (MS&I)). Recently, the realistic environment includes "falling in" on an on-going "mission training" event (e.g. warfighter, unit train-ups) by units preparing for return to Iraq and Afghanistan, also using these technologies. Future test and evaluation environments are expected to require 150,000 entities (objects and their attributes) within a large geographically dispersed and asymmetric battlespace. To support the future realistic operational environment requires large amounts of computing power and is created by utilizing numerous MS&I tools. Typically no one tool has the requisite granularity and capability required to represent the numerous aspects of the Warfighting Functions (Movement and Maneuver, Intelligence, Fires, Sustainment, Command and Control, Protection). Therefore multiple tools are required to operate together to create the robust environment in a near-seamless manner. The level of granularity will also define the architecture and protocols. The most common enabling protocols and architectures are Distributed

Interactive Simulation (DIS)/Protocol Data Units (PDU), HLA and Test and Training ENabling Architecture (TENA). The architecture and protocol output must be robust in order to reflect the MS&I tool granularity and fidelity.

Within the last year ATEC OTC, has conducted a series of IEs to "stand up" a MS&I capability which included a modest distributed capability and a robust HLA capability. A fully "distributed" HLA capability is expected in FY08 thru FY09. The tools utilized during these events have been termed "JOSIE+1." JOSIE is an acronym of acronyms and reflects a collaboration of multiple organizations, many are depicted below. Although, not specifically listed as a federation owner, the Cross Command Collaboration Effort (3CE) was a key player in the initial partnering between PM MATREX (RDECOM) and OASIS (ATEC-OTC). The numeric, "+1," represents additional capabilities added to the JOSIE federation. The "1" depicting the Multi-spectral Optical Simulation System (MOSS) from Redstone Technical Test Center (RTTC), the first addition federate to JOSIE.

- <u>Janus</u>. TRADOC Analysis Center (TRAC)-White Sands Missile Range (WSMR) and USAOTC. Scenario driver (threat and friendly)
- <u>OT-TES</u>. Operational Test – Tactical Engagement System. Real Time Casualty Assessment (RTCA). USAOTC and Project Manager for Instrumentation, Targets and Threat Simulators (PM ITTS), Orlando, FL. RTCA, live and constructive engagements.
- <u>STORM</u>. Simulation Testing Operations Rehearsal Model. USAOTC, Electronic Proving Ground (EPG)-Ft. Lewis, WA and Communications Electronics Research and Development Command (CERDEC)-Ft. Monmouth, NJ. Situation awareness (SA), lower tactical internet (blue).
- <u>IMASE</u>. Intelligence Modeling and Simulation for Evaluation. USAOTC Intelligence and Electronic Warfare Test Directorate (IEWTD), Fort Huachuca, AZ and PM-ITTS Threat Systems Management Office (TSMO)), Redstone Army Arsenal, Huntsville, AL. Intelligence Surveillance Reconnaissance (ISR) focused, scenario generation, simulator, and instrumentation.
- <u>ExCIS_FSA</u>. Extensible C4ISR Instrumentation Suite – Fire Support Application. USAOTC Fire Support Test Directorate (FSTD), Fort Sill, OK; Center for Agile Technologies, University of Texas (CAT:UT), Austin, TX and PM-ITTS, Orlando, FL. Fire and effects.
- <u>MOSS</u>. Multi-spectral Optical Simulation System. USA Developmental Test Command (USADTC), Redstone Technical Test Center (RTTC), Huntsville, AL. Infrared Scene Generator.
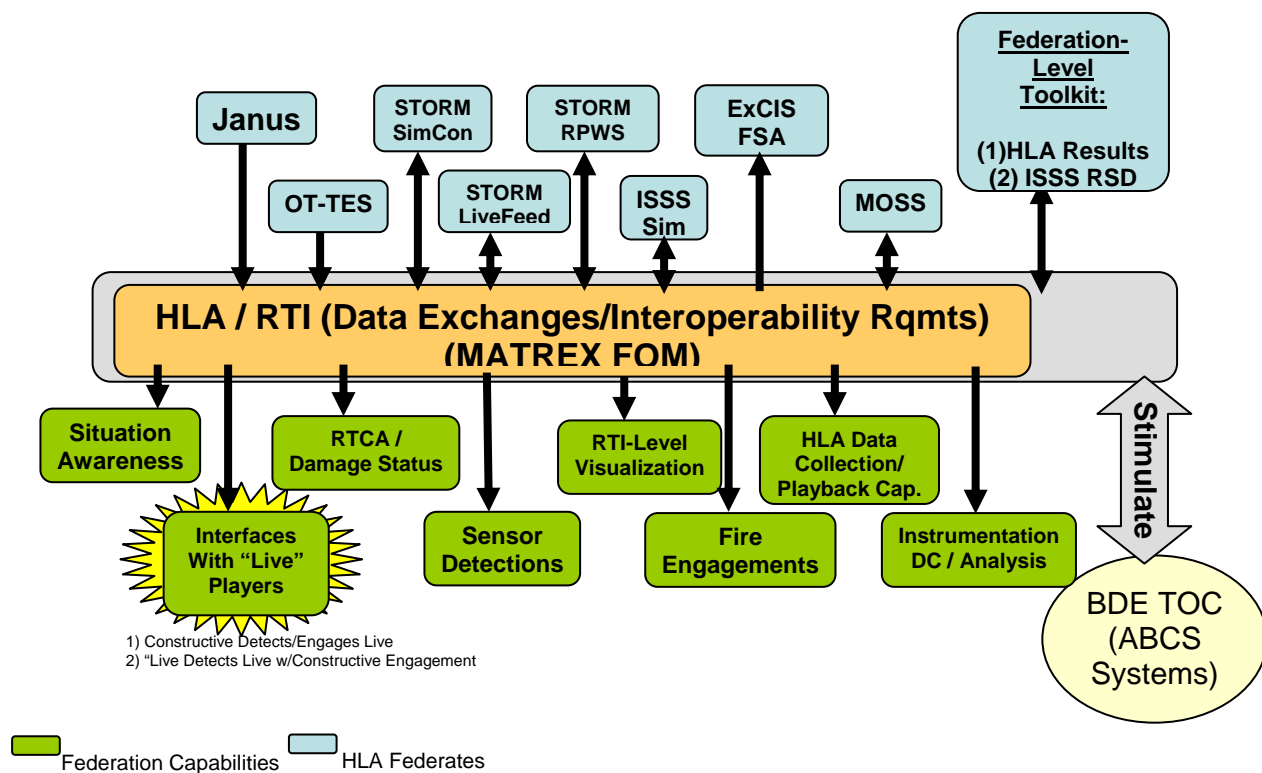
Figure 1. OASIS – JOSIE Integration Event VI, Federation Requirements / Capabilities

Integration Events, HLA. Beginning in January 2007 the OASIS-JOSIE federation began exploration of MS&I tool integration utilizing HLA. Through a series of integration events, the JOSIE federation began building their HLA capabilities, culminating in OASIS-JOSIE IE VI, 13-24 August, at the TTEC, Ft. Hood, TX. See Figure 1 for the JOSIE IE VI Federation Requirements / Capabilities. Numerous ramp-up activities were conducted in support of the OASIS JOSIE IEs. All activities followed the Simulation Interoperability Standards Organization (SISO) Federation Development and Execution Process (FEDEP) guidelines for creating HLA federations. First step in the process was establishing the federation requirements and objectives. Objectives included the creation of a federation using the JOSIE MS&I systems while keeping the same level of fidelity among the systems. Additional objectives were to use the MATREX version of the HLA RTI software and the MATREX FOM to support the data exchange and interoperability requirements. To accomplish this, a federation scenario was created that met the scenario data requirements for each of the M&S systems. The tactical situation included 4 blue brigade combat teams opposed by 4 threat brigades for a total of 6900+ simulation objects within the synthetic natural environment (SNE). After analyzing the networking requirements of each federate a network architecture was designed that met all federate needs. This included 9 HLA federates with a total of 15 computers. Capabilities demonstrated by the federation included: situation awareness, interfaces with live players, Real Time Casualty Assessment/Damage Status, sensor detections, RTI-level visualization, fire engagements and data collection/playback capability. The OASIS JOSIE IEs successfully demonstrated interoperability among the M&S systems which resulted in publishing a total of 2.6 million HLA object updates and over 60,000 HLA interactions during a four hour scenario vignette. JOSIE IE III thru JOSIE VI realized a number of significant firsts. They included:

- TTEC's Distributed Test Control Center (DTCC). First opportunity to use the TTEC's newly installed DTCC. In addition to standard DTCC capabilities, it allowed briefees to view JOSIE federate screens and Army Battle Command System (ABCS) Command and Control (C2) screens and scenario events on the enlarged DTCC screens rather than attempt to view on actual screens.

- Native HLA. All JOSIE systems were native HLA. Meaning no "gateways" or "translators." TTEC tactical operations center (TOC) connected to a "Live" Force XXI Battle Command Brigade and Below (FBCB2) vehicle. This allowed live OT-TES vehicles to "see" constructive threats via the FBCB2 system.

- Instrumentation. Although individual JOSIE members have utilized instrumentation for many years, IE V was the first opportunity for the JOSIE federation to use Instrumentation to collect data into/out of the TOC and into/out of the "Live" FBCB2 Vehicle.

- Fires and Effects, Thread 1. (See Figure 2) "Constructive entity engages and attrite live vehicles." First opportunity to use a "live" FBCB2-equipped vehicle in the JOSIE federation to demonstrate the "constructive on live" federation. A live OT-TES vehicle, depicted in the constructive simulation, was detected by a constructive Janus scout vehicle, nominated through the lower tactical internet (STORM), to the fire and effects structure, engaged by AFATDS and ExCIS-FSA, attrited in the simulation, and the engagement reflected on the "live" OT-TES vehicles by buzzing, flashing lights, and incapacitation of radios and weapons.   Engagement and Battle Damage Assessment (BDA) was depicted and viewed realtime by a MOSS IR sensor attached to an IMASE Unmanned Aerial System (UAS) which overflew the constructive engagement area. Data was collected, reduced and reviewed.
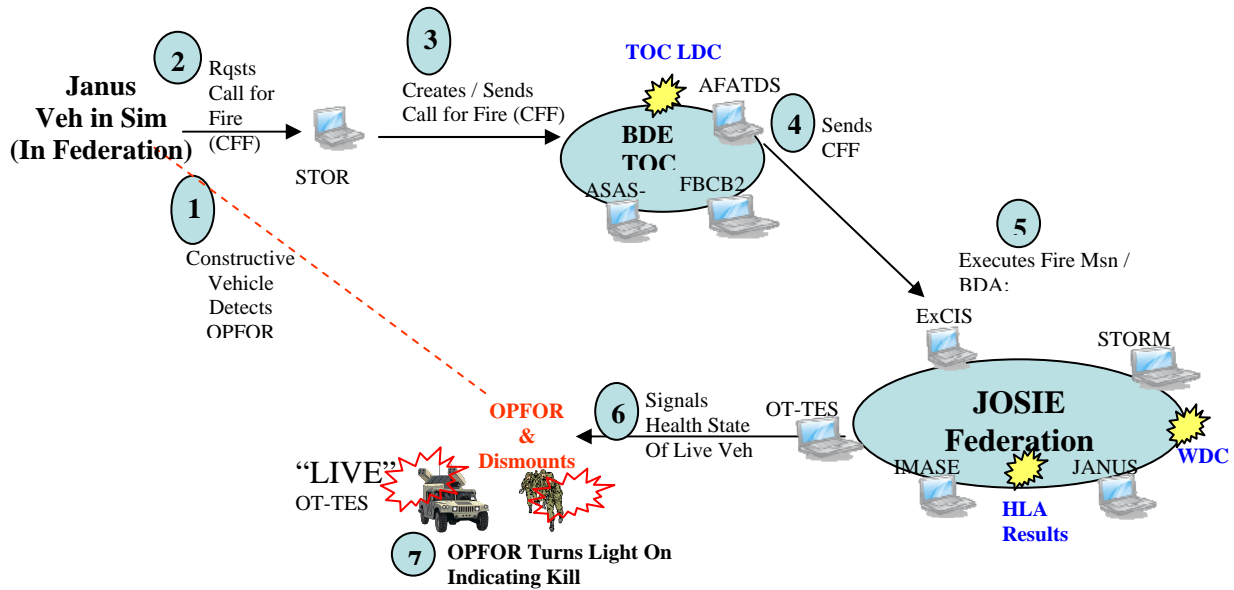
Figure 2. Fire & Effects. Thread 1, Constructive Engages Live

- Fires and Effects, Thread 2, "live vehicle detects live OPFOR vehicle." (See Figure 3). This engagement was different from the standard RTCA "laser pairing" engagement capability. Desire was to determine if engagement and attrition could be conducted within the constructive simulation environment. A "live" FBCB2 scout vehicle detected live opposing forces (OPFOR) vehicle and reported directly to the TOC FBCB2 radio, who reported to AFATDS, who engaged and attrited via ExCIS-FSA. The results were sent to the OT-TES system and resulted in buzzing, flashing lights, and incapacitation of radios and weapons on the OPFOR vehicle. MOSS equipped UAS sensor was flown similar to Thread one (above) to conduct BDA.
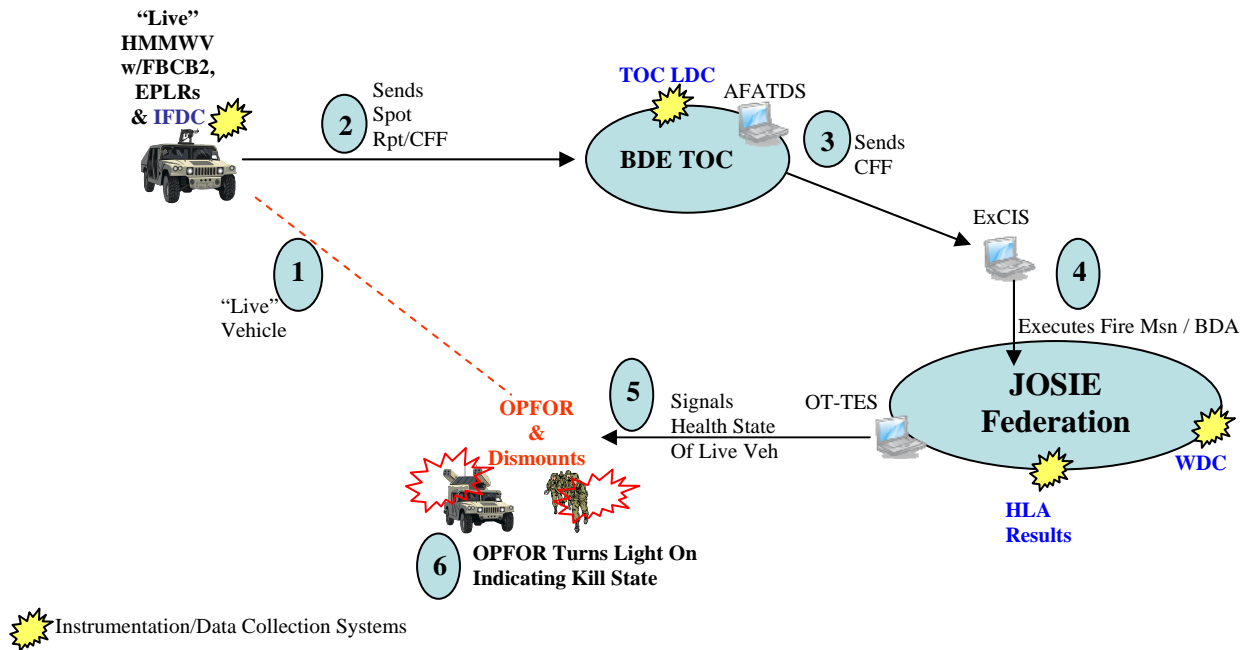
Figure 3. Fire & Effects. Thread 2, Live detects Live, attrited in the constructive (simulation)

Overall, the 2007 integration events have been very successful. The IEs have clearly demonstrated a number of firsts for USAOTC MS&I and its federation partners. Foremost among them was the seamless integration of live (OT-TES) and constructive (JSIE and MOSS) within a robust and high granularity environment. However, as mentioned earlier, this was made possible by the capability demonstrated by PM MATREX HLA and their responsive workforce. A discussion of a subset of the MATREX tools follows in paragraph two.


3. RDECOM/SOSI & MATREX Tools

RDECOM was established in 2004 by consolidating the Army's research, development and engineering (RD&E) Centers, the Army Research Laboratory (ARL), and the Army Materiel Systems Analysis Activity (AMSAA) into one Command composed of many world-class subordinate organizations. The resulting Command is greater than the sum of its parts. RDECOM has the formidable task of executing the Army's overall RD&E investment strategy. The goal is to provide the Army with the largest possible return on its RD&E investment. RDECOM is comprised of nine distinct, mission-oriented, research and development laboratories, activities and centers. These organizations employ very detailed and highly accurate physics-based models for the technologies, capabilities, and systems being studied and analyzed for potential acquisition, upgrade or sustainment throughout the product life-cycle.

Within RDECOM lies the Systems of Systems Integration (SOSI) organization which is a component of the RDECOM HQ Staff. The mission of the SOSI organization is "to deliver the right technology information at the right time – for the Decision Maker and Warfighter." The Enterprise Capabilities Directorate (ECD) is the directorate within the SOSI organization responsible for execution of the MATREX program.

The Army began the MATREX effort in 2003 as a Science and Technology Objective (STO) with stated goals of (1) designing a simulation architecture, (2) integrating a reference implementation that would represent the key characteristics of network enabled battle command warfighting systems, and (3) building a suite of supporting M&S tools. The STO sought to provide a secure, persistent environment to support the evaluation of the concepts and technologies associated with Army transformation.

Most of these transforming concepts and technologies are heavily reliant upon net-centricity and carry an underlying assumption that the whole of the system will provide greater military utility than would the sum of the individual parts. This necessitates a thorough understanding of system interdependencies whose military value can only be fully comprehended at a Systems of Systems (SoS) view. Whether operating at the platform/entity-level, or focused on a narrowly-defined engineering-level slice, or scaled-up to a full Brigade Combat Team, the MATREX environment sought to enable an improved SoS view by addressing deficiencies in domain-specific, stove-piped M&S and data that often failed to be interoperable or reusable. MATREX was thus chartered to integrate that SoS perspective over the full range of both M&S system and technical expertise within the U.S. Army RDECOM.

The MATREX is first and foremost a service-oriented architecture, providing a computer based synthetic environment in which services exchange object data through a RTI. The MATREX components cover a broad spectrum of capabilities from battle command, survivability, communications, vehicle dynamics, sensors, ordnance, logistics, and damage effects, to human performance. Accompanying the components are various tools provided by the MATREX program to assist in the integration effort.
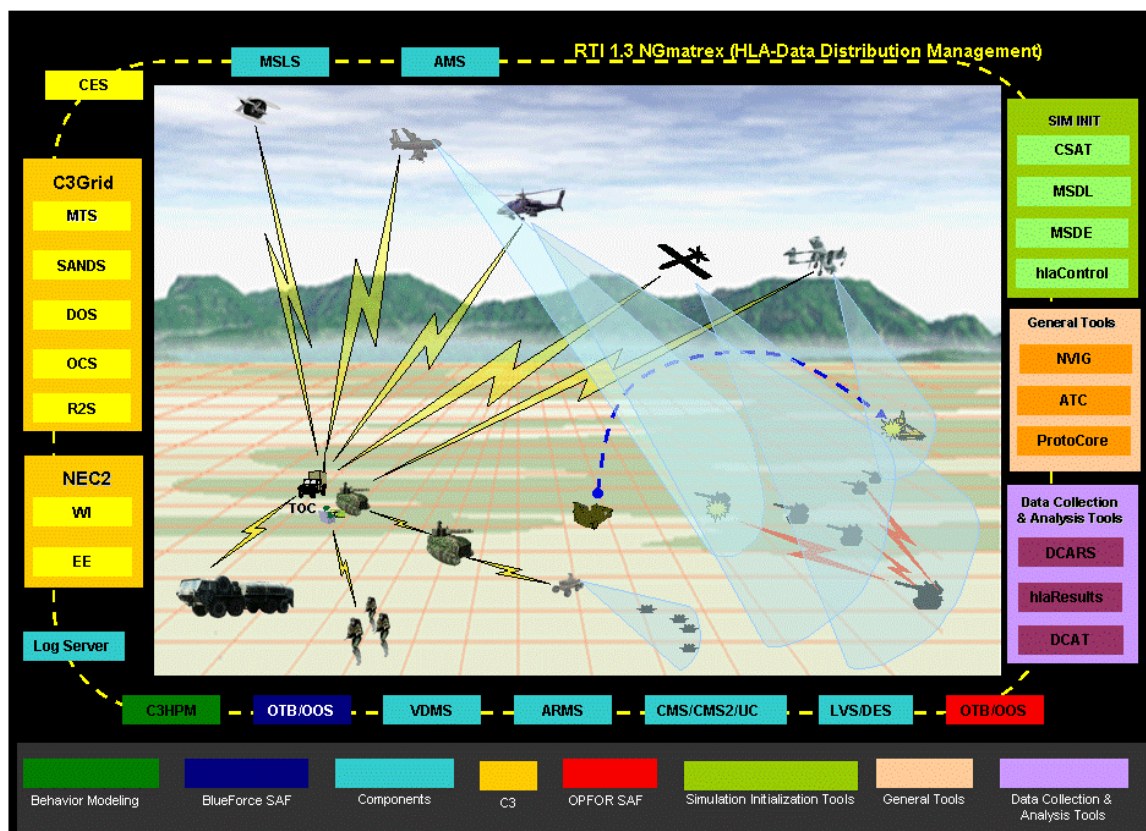
For this specific OTC/MATREX collaborative effort, MATREX assisted OTC in using the following GFX tools provided by MATREX. The SDD is designed to specify the full system architecture for MATREX, including the semantics and object model information. The information is represented in a way that is not tied directly to any transport layer protocol. This allows simulation architects to talk about design without getting mired in protocol specific behaviors. It also provides a better means to incorporate design elements to support live assets and assess the impact on the existing system design and simulators. MATREX supports the Future Combat System (FCS) Simulation Environment (FSE) by collaborating with the FCS Program in the SDD. The design is managed by a co-chaired (FCS and MATREX) FOM Management Focus Group (FMFG). This allows cross collaboration on the architecture of systems and the implementation of simulations. This also helps to attain a collaborated solution to Army simulation that 3CE can leverage. The SDD provides a robust process to incorporate the capabilities of OTC's live interoperability and assess the impact upon existing simulations. It also then provides a means to bring that capability to a larger M&S community.

Another tool used by OTC was ProtoCore. **ProtoCore** is a tool which provides the runtime translation of the data elements from the SDD, expressed in terms of the Object Model, into the desired transport protocol. This allows simulation developers to concentrate on their model's business logic independent of the underlying simulation infrastructure. ProtoCore also uses a plug-in architecture to allow the analyst or modeler to pick which transport to use at runtime. ProtoCore currently supports HLA1.3 and HLA1516. A future plug-in for TENA is due to be completed in FY08. The MATREX program periodically conducts a ProtoCore workshop to do hands-on porting of federates to ProtoCore. Recently, over a five day period, five components were ported and tested in an HLA federation. The ProtoCore currently supports both Java and C++ programming languages.

ProtoCore Object Model Architecture

G Smith 7/07
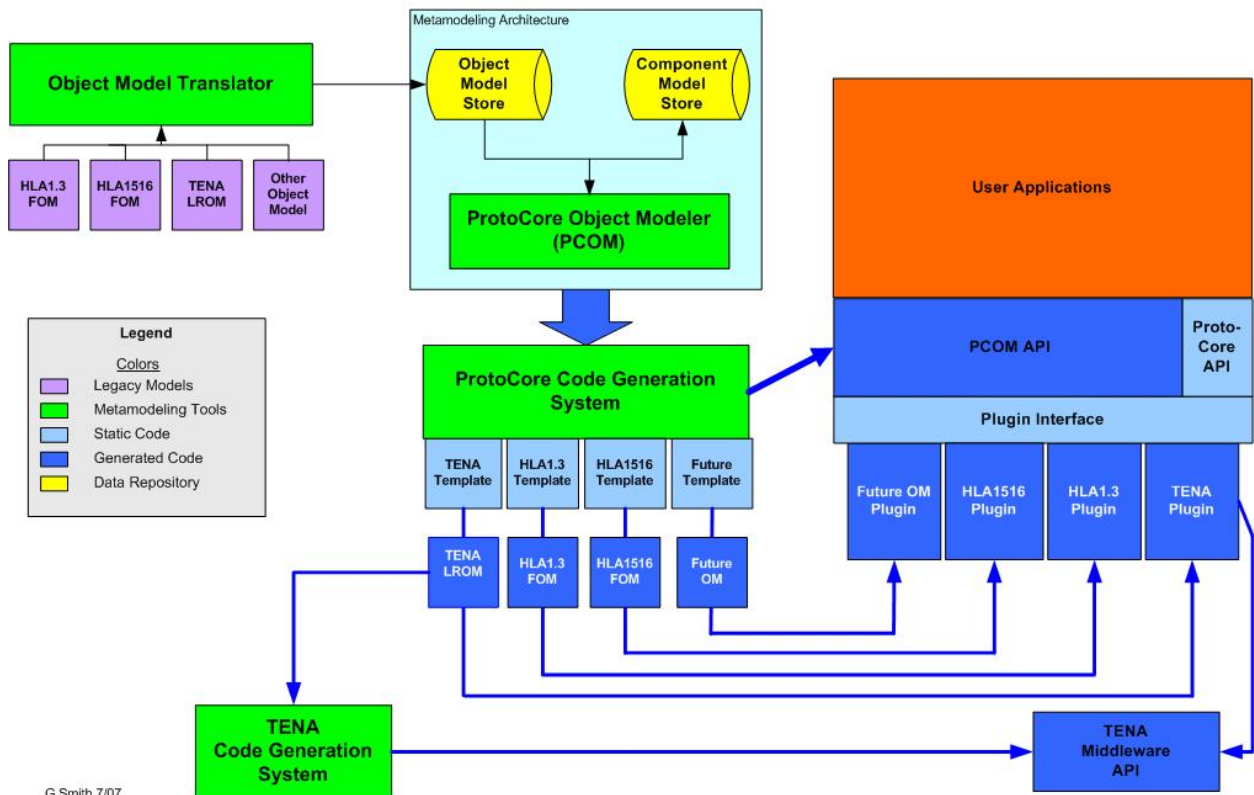
A tool used to test system functionality is also critical in this effort to ensure a valid training and simulation environment as well as speed development and integration times. The SDD, which contains the semantic behavior along with the data elements, allows the component developer to create test cases based on agreed upon functionality. MATREX has a tool to take advantage of that capability, the *Advanced Testing Capability (ATC)*. This tool allows for repeatable black-box testing of a single simulator or multiple simulators running together. ATC also allows for multiple actors to be simulated. It gives the user the flexibility to test functionality prior to engaging in a larger and more expensive full-up federation testing. Ensuring a full set of ATC test cases, which each component is required to pass helps reduce time and monetary costs in integrating the simulation.

4. Summary
Without doubt OASIS (JOSIE) and MATREX developed a beneficial partnership through sharing technologies and capabilities that should further leverage the feasibility of a 3CE solution to modeling, simulation, testing, and validation of legacy, current, and future systems and architectures. During the numerous JOSIE IE briefings and demonstrations during the year, numerous attendees representing the testing, training, acquisition, and Joint communities were in agreement on the future utility of the JOSIE efforts and successes. In short, this was a mutually beneficial partnership and lays the foundation for continued exploration and benefit to the community at large. In the future, both parties look forward to integrating each organizations capabilities into each others interoperable environments.

Acronym List

ABCS	Army Battle Command System
AFATDS	Army Field Artillery Target Data System
API	Application Programming Interface
ATC	Advanced Testing Capability
BDA	Battle Damage Assessment
C2	Command and Control
CAT:UT	Center for Agile Technologies: University of Texas
CFF	Call For Fire
CDL	Common Data Link
CERDEC	Communications Electronic Research Development Command
COP	Common Operating Picture
DIS	Distributed Interactive Simulation
DTC	Developmental Test Command
DTCC	Distributed Test Control Center
EPG	Electronic Proving Ground
ExCIS-FSA	Extensible C4I Instrumentation Suite – Fire Support Application
FBCB2	Force XXI Battle Command Brigade and Below
FCS	Future Combat System
FEDEP	FEderation DEvelopment and Execution Process
FOM	Federation Object Model
FSE	FCS Simulation Environment
HLA	High Level Architecture
IEWTD	Intelligence Electronic Warfare Test Directorate
IMASE	Intelligence Modeling and Simulation for Evaluation
ISR	Intelligence, Surveillance, and Reconnaissance
ISSS	IMASE-Simulation Scoring Subsystem
Janus	-Not an acronym
JOSIE	Janus, OT-TES, STORM, IMASE, ExCIS-FSA
LDC	Local Area Network Data Collector
LVC	Live, Virtual, and Constructive
M&S	Modeling and Simulation
MS&I	Modeling, Simulation and Instrumentation
MATREX	Modeling Architecture for Technology, Research, and EXperimentation
MOSS	Multi-spectral Optical Sensor System
OASIS	Operational Test Command Analytical Simulation and Instrumentation Suite
OPFOR	Opposing Force
OT-TES	Operational Test Tactical Engagement System
PDU	Protocol Data Units
PM	Program Manager
PM-ITTS	Program Manager - Instrumentation, Targets and Threat Simulators
RDECOM	Research and Development Command
RSD	Real-time Situation Display
RTI	Run-time Interface
RTTC	Redstone Technical Test Center
RTCA	Real Time Casualty Assessment

SA	Situation Awareness
SAF	Semi-automated Forces
SDD	System Design Description
SISO	Simulation Interoperability Standards Organizations
SNE	Synthetic Natural Environment
STORM	Simulation Testing Operations Rehearsal Model
TENA	Test and Training Enabling Architecture
TTD	Transformation Technology Directorate
TOC	Tactical Operations Center
TSMO	Threat Systems Management Office
TTEC	Transformation Technology Execution Center
USAOTC	US Army Operational Test Command
USATEC	US Army Test and Evaluation Command
WDC	Wide Area Network Data Collection
3CE	Cross Command Collaborative Effort

Biographies

Gary Smith is the Design and Development Lead for Modeling Architecture for Technology and Research EXperimentation, (MATREX) with the Research and Development Command (RDECOM) in Burke, VA. He has extensive software engineering and code development experience in the areas of modeling and simulation within the DoD community. He has a Bachelor's Degree in Mathematics from St. Mary's College of Maryland.

Keith Snively is a Senior Software Engineer with Dynamic Animation Systems Inc. He has over ten years experience in DoD modeling and simulation. His experience includes several years working on Design and Development of the DMSO RTI-NG. He has also worked on development for the TENA middleware. Recently Mr. Snively participated in the development of the HLA 1516 Evolved specification. Currently Mr. Snively serves as a software developer for the MATREX program and specifically supports design and development of the MATREX RTI-NG and ProtoCore.

Jimmie S. Smith is currently the OTC Analytic Simulation Instrumentation Suite (OASIS) Integration Manager for the USATEC, USAOTC, Transformation Technology Directorate (TTD), Fort Hood, TX. He has extensive program management experience and also M&S experience in the areas of ISR testing and ISR training. He is a former Infantry and Military Intelligence Officer. He holds a Master of Business Administration from Golden Gate University, San Francisco, CA, and a Bachelor of Applied Resources from Troy State University, Troy, AL.

Lori A. Butler is currently the OASIS-JOSIE Integration Lead for USATEC, USAOTC, Transformation Technology Directorate, Fort Hood, TX. She is an Operations Research Systems Analyst (ORSA) and has extensive test and evaluation and software development expertise while performing duties as the IMASE-ISSS software development lead. She holds a Master of Science in Information Technology from Tarleton State University and Bachelor of Science Degree in Science Education from the University of Delaware.

USAOTC – PM MATREX
Live & Constructive Teaming

Jimmie Smith, OASIS Integration Mgr
Gary Smith, MATREX Program (Design & Dev. Lead)

- ## Background

- ## The Federation

- ## Live – Constructive

  - Constructive detects Live, engaged & attrited in Constructive

  - Live detects Live, engaged & attrited in Constructive

- ## MATREX

  - Benefits
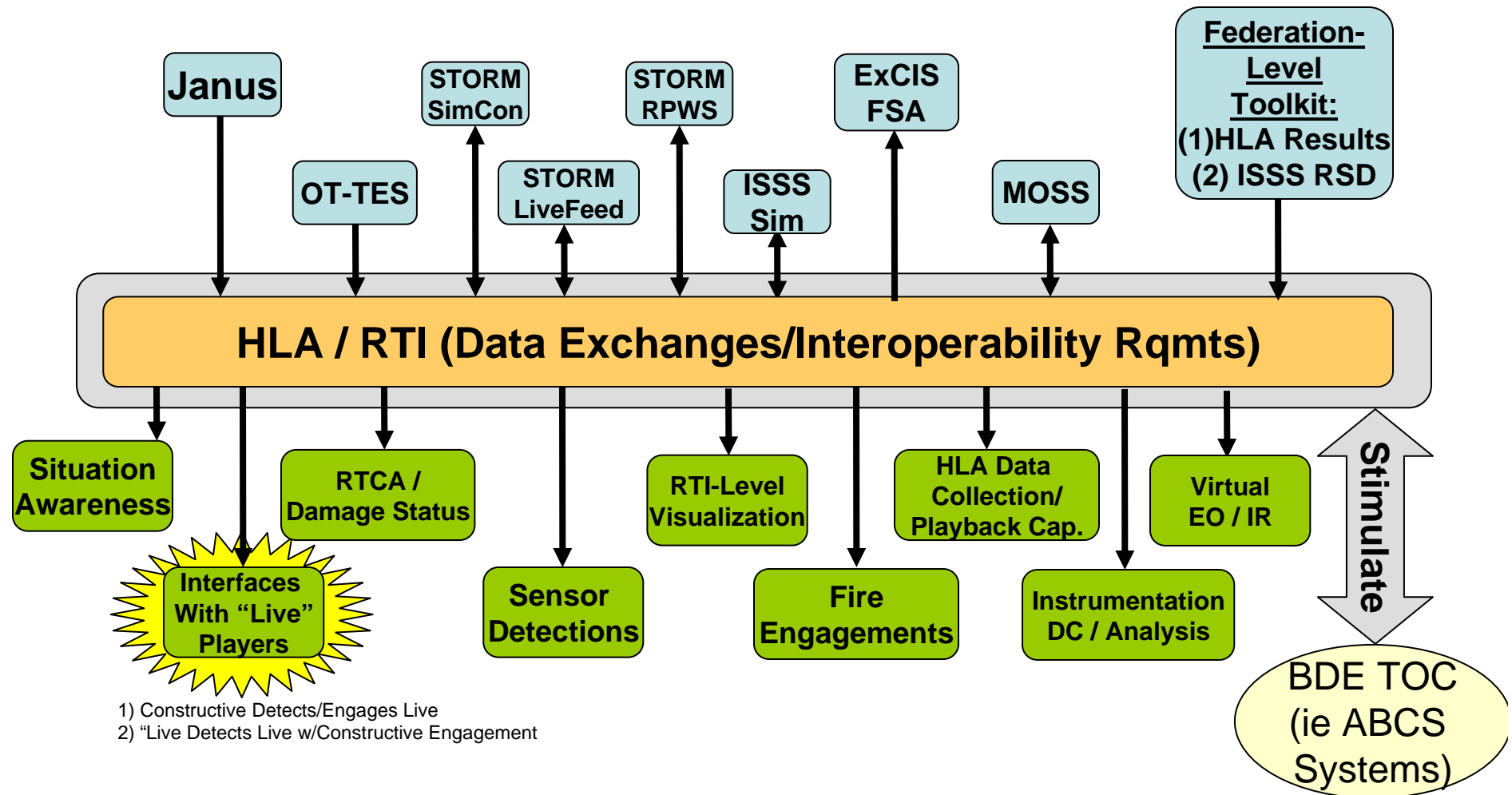
  - Tools / Documentation

- ## Teaming Benefits

- ## Teaming initiatives
  - Close working relationship during initial establishment of OTC OASIS-JOSIE Federation.
  - RDECOM responsiveness to OTC federation needs

- ## Support to OTC
  - ATEC established requirement for HLA
  - OTC developed plan
  - OTC introduced to MATREX via 3CE
  - Initial discussions and plan for the plan
  - JOSIE established and integration tested over 5 month period
  - Initial return on investment includes:
    - Teaming realized resource savings (time, money, cost avoidance)
    - Potential for real money savings during the on-going process.
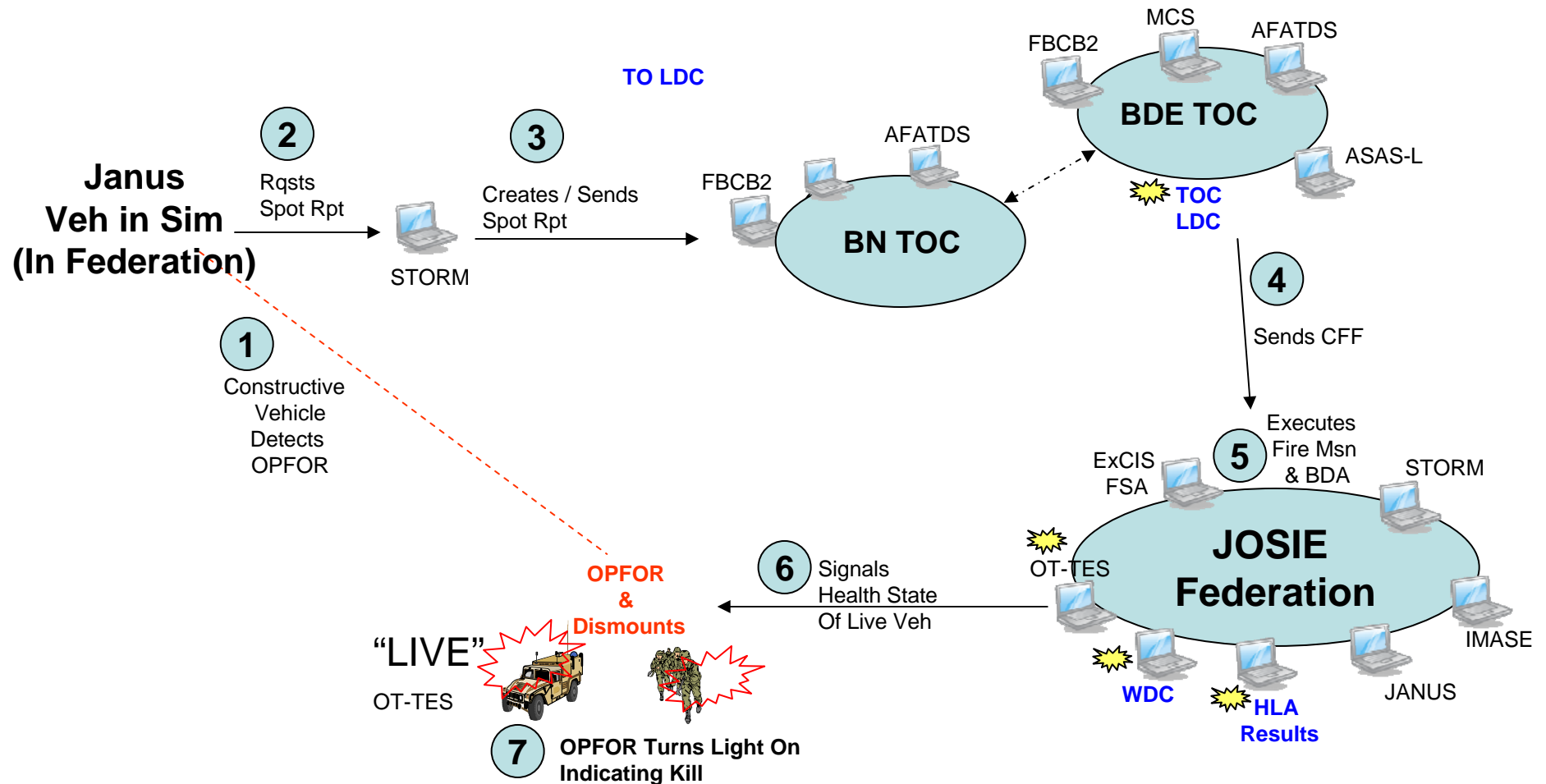
JOSIE+1 FEDERATION
(Federates vs. Capabilities)

Janus

OT-TES

STORM SimCon

STORM LiveFeed

STORM RPWS

ISSS Sim

ExCIS FSA

MOSS

Federation- Level Toolkit:
(1)HLA Results
(2) ISSS RSD

HLA / RTI (Data Exchanges/Interoperability Rqmts)

Situation Awareness

RTCA / Damage Status

RTI-Level Visualization

HLA Data Collection/ Playback Cap.

Virtual EO / IR

Interfaces With "Live" Players

Sensor Detections

Fire Engagements

Instrumentation DC / Analysis

Stimulate

BDE TOC (ie ABCS Systems)

1) Constructive Detects/Engages Live
2) "Live Detects Live w/Constructive Engagement

■ Federation Capabilities   ■ HLA Federates

US Army Operational Test Command

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Janus Veh in Sim (In Federation)

(2) Rqsts Spot Rpt

(3) Creates / Sends Spot Rpt

TO LDC

STORM

FBCB2 AFATDS

BN TOC

FBCB2 MCS AFATDS

BDE TOC

ASAS-L

TOC LDC

(1) Constructive Vehicle Detects OPFOR

(4) Sends CFF

(5) Executes Fire Msn & BDA

ExCIS FSA STORM

OT-TES

JOSIE Federation

IMASE

WDC **HLA Results** JANUS

(6) Signals Health State Of Live Veh

OPFOR & Dismounts

"LIVE"

OT-TES

(7) OPFOR Turns Light On Indicating Kill

Instrumentation/Data Collection Systems

"Live" HMMWV w/FBCB2, EPLRs & IFDC

2 Sends Spot Rpt

BN TOC
- FBCB2
- AFATDS

BDE TOC
- FBCB2
- MCS
- AFATDS
- PASS Server
- ASAS-L

TOC LDC

3 Sends CFF

1 "Live" Vehicle Detects OPFOR

Thread #2

JOSIE Federation
- ExCIS FSA
- **4** Executes Fire Msn & BDA
- STORM
- OT-TES
- WDC
- **HLA Results**
- JANUS
- IMASE

5 Signals Health State Of Live Veh

OPFOR & Dismounts

6 OPFOR Turns Light On Indicating Kill

Thread #3

⚡ Instrumentation/Data Collection Systems

MATREX

Benefits of MATREX:

- Enables configuration and reuse of components for:
  - Engineering model development and evaluation
  - Technology tradeoffs
  - Capabilities assessments
  - Concept development
  - Experimentation and testing
- Mutually and collectively leverages the world-class expertise of all RDECOM M&S laboratories for the benefit of the Army
- Supports decision making over the entire acquisition cycle

MATREX is: A composable M&S environment wherein a collection of multi-fidelity models, simulations, and tools are integrated into an established architecture to conduct analyses, experimentation, and technology trade-offs for RDECOM and others.

- **RTI (Run-Time Infrastructure)**
  - High Level Architecture (HLA) is an architecture for supporting reuse and interoperability for distributed Modeling and Simulation. Two existing specifications:
    - DoD HLA 1.3
    - IEEE 1516 HLA
    - Coming soon: IEEE 1516 Evolved HLA
  - RTI is the software execution component of HLA. The RTI software provides a set of services used by federates to coordinate their operations and data exchange during a runtime execution, including distributed execution.

- **ATC (Automatic Test Capability)**
  - Provides users the capability to build, store and execute tests for components built on the MATREX tools
  - Provides the capability to perform traceable and repeatable black-box testing on an individual components build on the MATREX tools
  - Allows developers to test their individual components without having to bring up the entire federation, making debugging easier, faster, and lowering the cost of testing
  - Allows the Integration and Test team to debug issues during integration
  - Can be used as an acceptance test for new and updated components

- **SDD (System Design Description)**
  - SDD provides a top level Systems Engineering perspective through identification of the who, what, how, and requirements that then propagate to form the contract by which the community delivers to MATREX.
  - Separation of requirements, functionality, architectural strategies, design decisions and component allocation
  - Federate contractual responsibilities derived directly from the SDD
    - Pub/Sub matrix, Test Cases, etc.
  - The linkage to the FOM is maintained
    - Provides insight into what portions of the FOM are being used and how they are being used
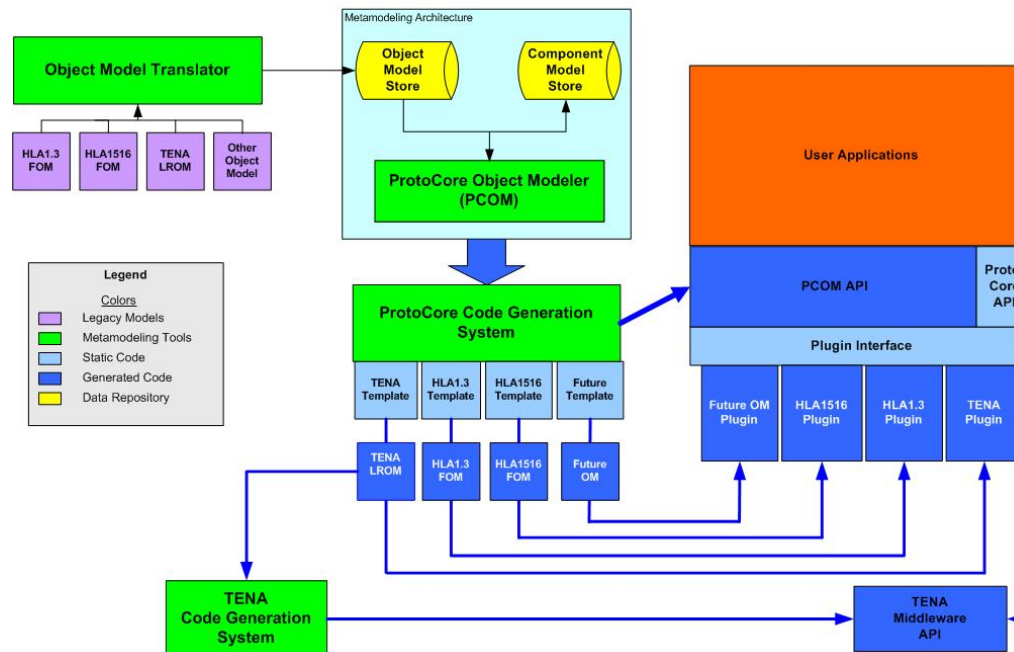
ProtoCore Object Model Architecture

- **ProtoCore**
  - Provide modern Object Oriented and type-safe Application Programming Interface (API) to distributed simulation services
    - Provide automatic handling of menial tasks, such as data marshalling, required for some infrastructures.
    - Type-safe API allows more errors to be caught at compile time rather than runtime.
  - Provide mechanism to connect API to various network protocols in near-term and minimize cost, work, and time of moving applications between them
    - Code-Generate connectivity to protocols from a common Object Model
    - Plug-in architecture used to allow single application binary to run over various protocols without modification.
  - Leverage existing software investments and minimize impact of reuse across Army
  - Provide a forward path for legacy object models and component models into the future

US Army Operational Test Command

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Teaming Benefits

- Shared technologies and capabilities for leveraging 3CE solution to modeling, simulation, testing and validation of legacy, current, and future systems and architectures.

- Added L- C capability to MATREX, exploration for V continues

- OTC has transitioned to a solution that will enable future compliance with other standards such as TENA and HLA1516.

- Forum for ATEC access to RDECOM capabilities.

- A key and successful demonstration of MATREX capabilities and their applicability outside the RDECOM environment

- Developing venue for collaboration between USAOTC, PM ITTS, and MATREX for co-development of M&S, processes and tools

Questions?
or
Comments?